Flow control and its impact on avalanche dynamics in a basic transport experiment

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Results of a basic heat transport experiment[1,2] involving an off-axis heat source are presented. Experiments are performed in the Large Plasma Device (LAPD) at UCLA. A ring-shaped electron beam source injects low energy electrons (below ionization energy) along a strong magnetic field into a pre-existing, large and cold plasma. The injected electrons provide an off-axis heat source that results in a long, hollow, cylindrical region of elevated plasma pressure embedded in a colder plasma, and far from the machine walls. The off-axis source is active for a period long compared to the density decay time, i.e. as time progresses the power per particle increases. Two distinct regimes are observed to take place, an initial regime dominated by avalanches, identified as sudden intermittent rearrangements of the pressure profile, and a second regime dominated by sustained drift-Alfven wave activity following a global collapse of the density profile. The avalanches are triggered by the rapid growth of drift-Alfven waves. The data suggest that flows play a critical role in the dynamics, in particular in the onset of the avalanches through the interplay of the stabilizing flow shear and the destabilizing pressure gradient. The flows are imposed by the boundary condition at the ring-source. This source has now been modified from previous experiments to gain active control of the flows by controlling the bias between the emitting ring and surrounding carbon masks. A regime was found in which avalanches are absent. The new source also provides some control over the size and frequency of avalanches when present.

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[1]*B. Van Compernolle et al. Phys Rev. E 91, 031102 (2015)*

[2]*B. Van Compernolle et al, Phys. Plasmas 24, 112302 (2017)*